Air and Ground ATM Systems Integration Need or Fashion ...

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« Air-Ground ATM Systems Integration » to day

- It does exist today if it means Systems where functions are splitted over Air and Ground, ex:
  - ✓Instrument Landing Systems
  - ✓NAVAIDS Systems

BUT

- It is partial aircraft per aircraft
- It addresses only one function at the time
- Air and Ground have developed sophisticated BUT independant functionalities
- Things will dramatically change over the next 15 years

What is changing?
Vision 2020: A European View

- Implementation of a seamless Air Traffic Management (ATM) system
- At least double airspace capacity while increasing safety over 2004-2020
- Implementation of sophisticated ground and satellite-based communication, navigation and surveillance systems
- Noise nuisance is much reduced
- Aircraft are running on schedule 99% of the time in all weather conditions.

European Aeronautics: A Vision for 2020

- Air Traffic Management: Single European Sky programme initiative should be developed based on a Master Plan .

Strategic Aerospace Review for the 21st century (STAR 21)

Only a uniform and globally interoperable ATM system can meet Europe 's needs for a highly efficient and seamless Air Transport

What is going wrong with the today situation …

●Air and Ground have developed sophisticated but independent functionalities

- ✓ Airlines :Flight Operations optimisation (AOC)
- ✓ ATSP's and ATC bodies : Strategic and Tactical tools for aircraft separation and flow optimisation
- ✓ Airports : Surface Movement optimisation tools
- ✓ Aircraft and Avionics manufacturers: On board computers for flight profile optimisation (FMS)

B U T

●The Air and Ground actors have different goals with different constraints

- ✓ Airlines want to optimise globally their flights ops network given economical constraints
- ✓ ATSP's want to optimise the Airspace given separation and safety constraints
- ✓ Airports want to optimise gates, apron, taxiways and runways usage
- ✓ Aircraft want to optimise the way to fly from point A to point B given their own constraints (Wind, Temp,Wx)

The actors are using roughly the same primary data but having different goals they may reach different conclusions

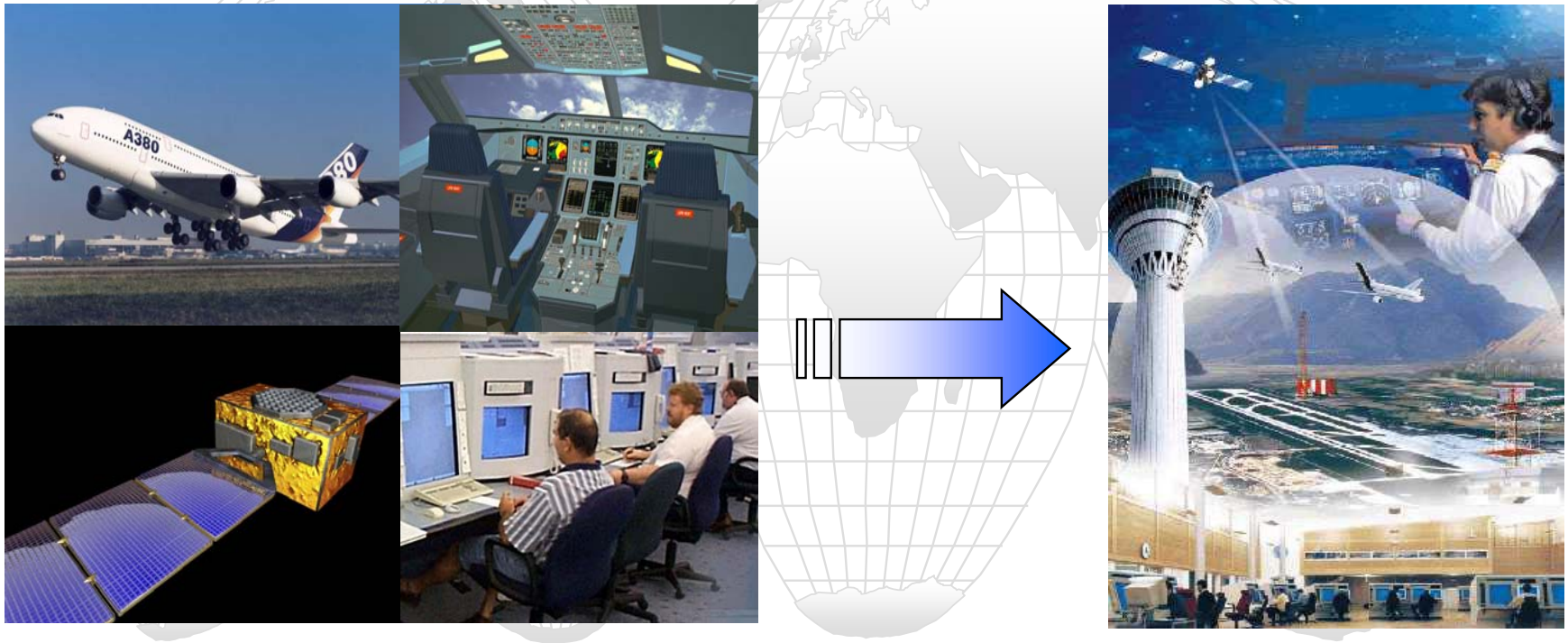
What is going to change…

An Aircraft is no more an isolated flying object controled from the ground but one element of a « flying network »

- **The present Village Thinking syndrom**
  - ✓Lack of global communication
  - ✓Lack of data sharing
  - ✓Local decisions
  - ✓« Confort » margin at each village level
  - ✓Local optimisation but poor global efficiency

- **The needed Global Picture**
  - ✓Need for a common operational vision
  - ✓Need for global interoperability
  - ✓Need for data pooling
  - ✓Need for data sharing
  - ✓Need for network-integrated operations
  - ✓Need for Common Decision Making

The necessary Migration



From Fragmentation to Integration

A Possible Operational Vision for 2020+

- **The future ATM should be a "Performance Based System":**
  - ✓ **Strategically based on 4D trajectory exchange and optimization led by the ground side**
  - ✓ **Tactically based on a certain degree of migration of A/C separation control to the Flight Deck through ASAS (TBD) functionalities**
- **with Real-Time information (flight object) sharing between all participants, supporting Collaborative Decision Making**
- **with Airspace Structure optimization based upon advanced navigational capabilities**
- **with flexible and dynamic allocation of Airspace optimizing routing and maximizing capacity**
- **"User preferred routing" when and where possible**

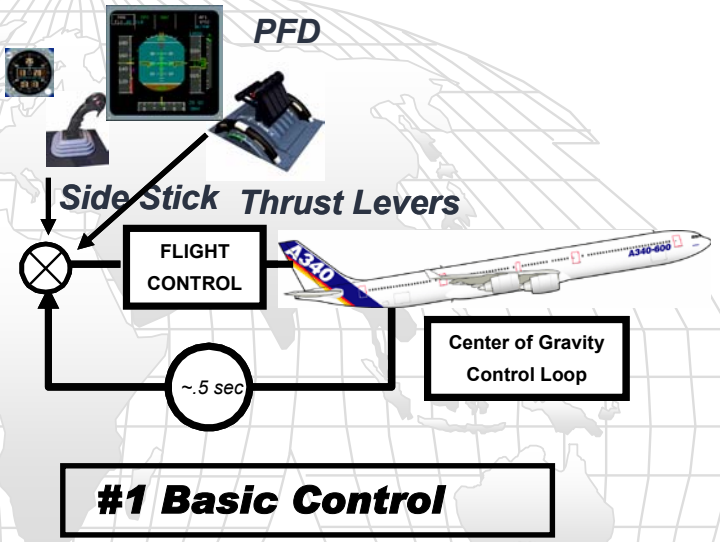
Need for New Air/Ground Traffic Solutions

Key Challenges for the Suppliers Industry:

ground ATM - Aircraft - Avionics - Satellites

- ✓ **Fully integrate Aircraft/avionics with ground ATM systems : new dimension in human factors *(pilot and controller)***
- ✓ ***Assess and implement new On Board & Ground functionalities***
- ✓ **Implement a new Communication, Navigation *(Galileo,..)* and Surveillance infrastructure**
- ✓ **Implement a new Collaborative Decision Making infrastructure linking Airlines and Airport Operations with ATC Ops**

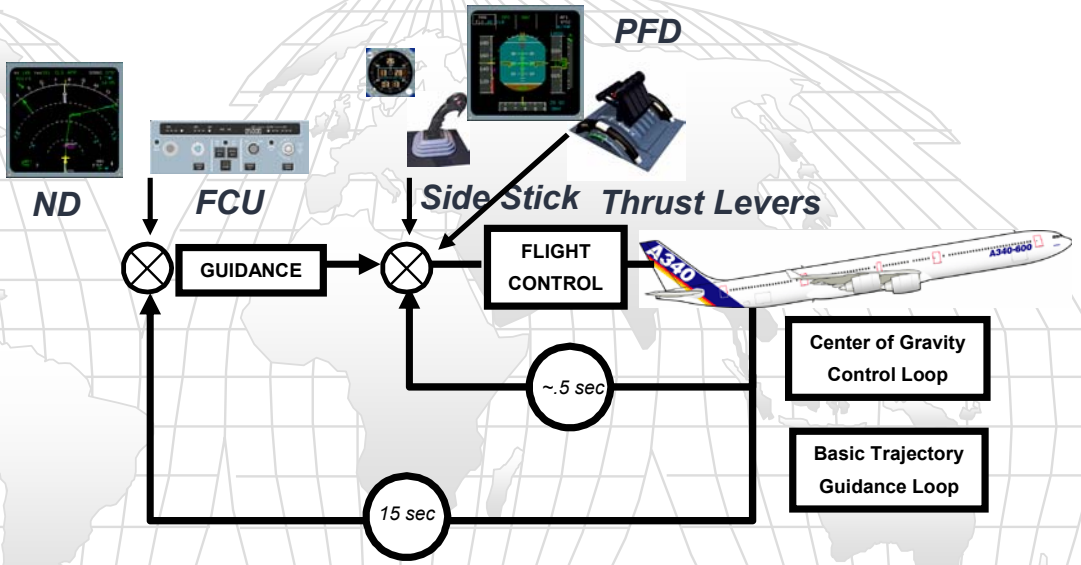
The 4 Flight Control Loops



- *Mainly Human centered*
- *Pilot's inputs*
  - *Side Stick or Control Column*
  - *Thrust levers*
  - *Flaps/Slats*

PFD : Primary Flight Display

The 4 Flight Control Loops

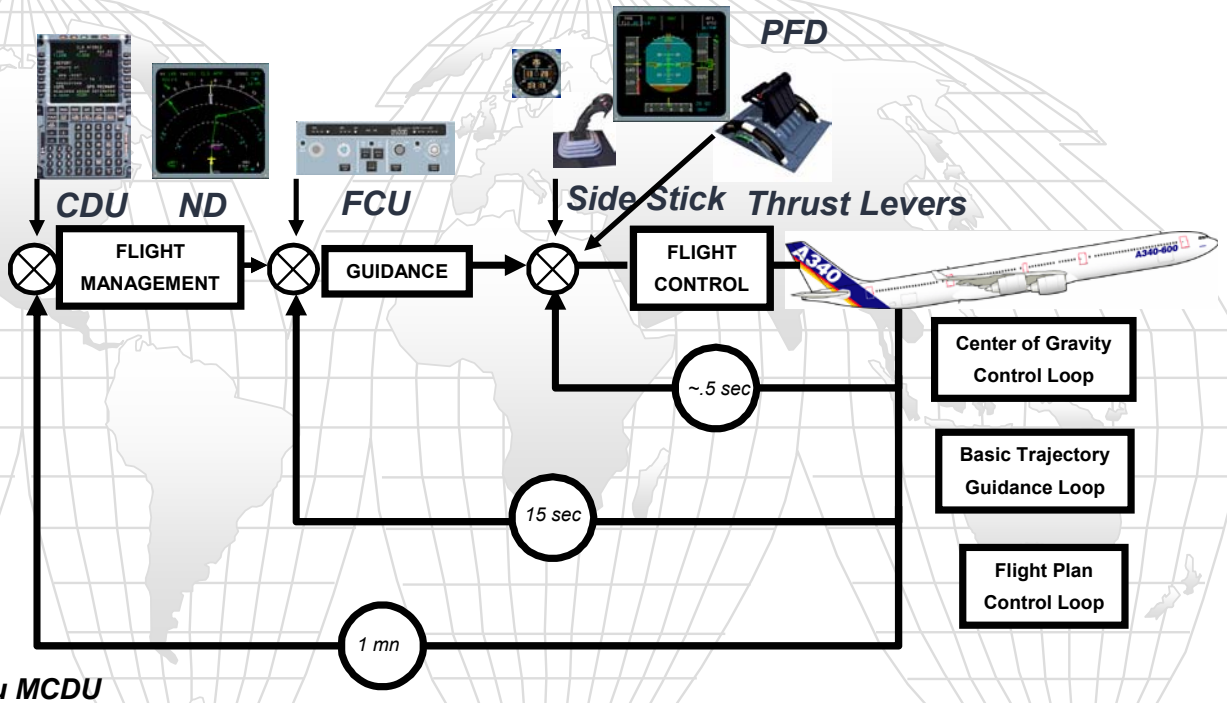


- *Superimposed to #1*
- *Additional Pilot's inputs thru FCU*
  - *Altitude, Airspeed, Vert Speed*
  - *Heading*

  For parameters acquisition & hold

PFD : Primary Flight Display
FCU : Flight Control Unit
ND : Navigation Display

The 4 Flight Control Loops

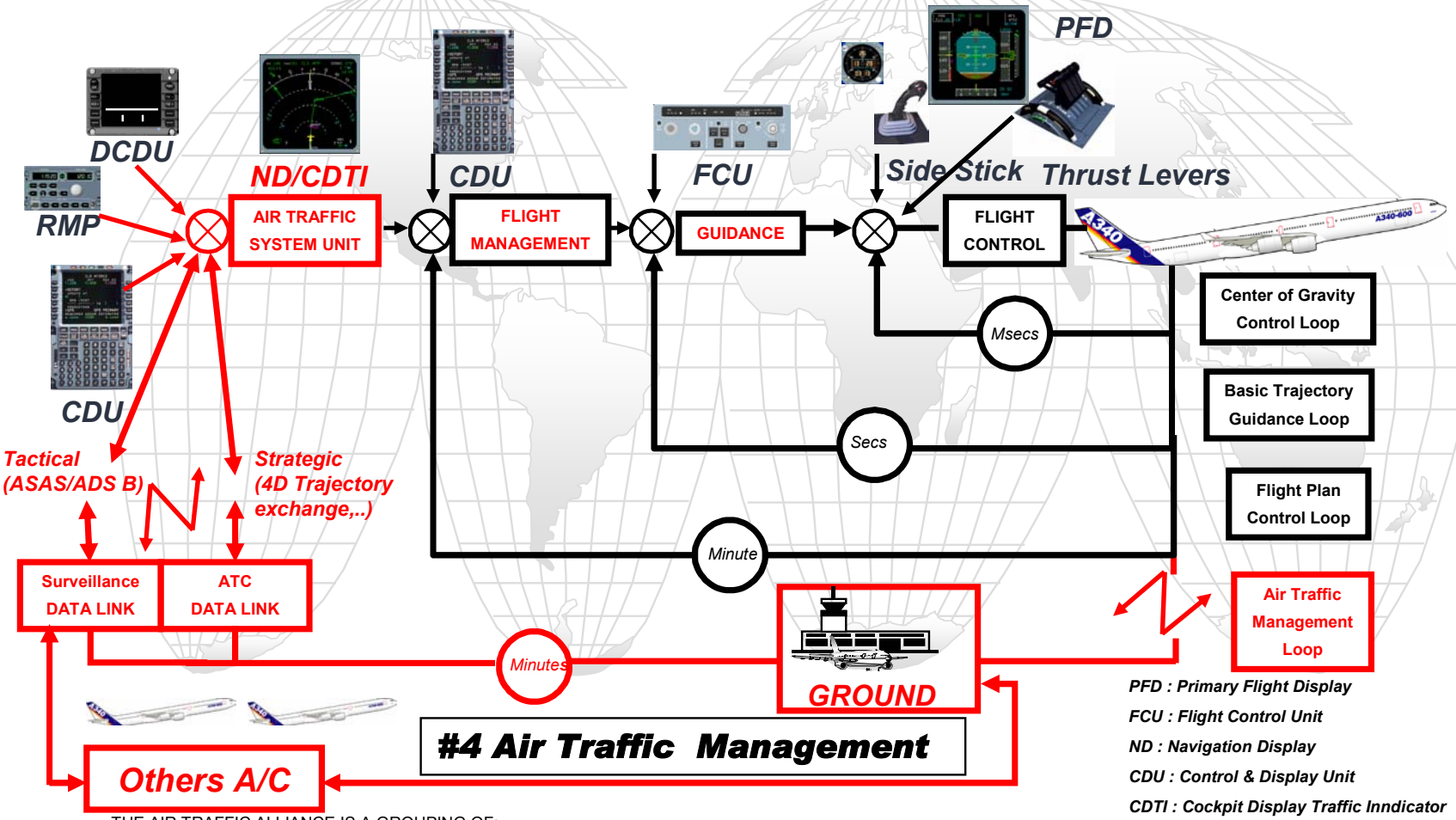


- *Superimposed to #1 and #2*
- *Additional Pilot's inputs thru MCDU*
  - *Routes selection and control*
  - *Horizontal NAV (WP's)*
  - *Vertical NAV*

#3 Flight Plan Management

PFD : Primary Flight Display
FCU : Flight Control Unit
ND : Navigation Display
CDU : Control & Display Unit

The 4 Flight Control Loops



PFD : Primary Flight Display
FCU : Flight Control Unit
ND : Navigation Display
CDU : Control & Display Unit
CDTI : Cockpit Display Traffic Inndicator
DCDU : Data link Control & Display Unit
RMP : Radio Management Panel

The Loop #4 Impact on «On Board» functions

Strategic functionalities

Tactical functionalities

4D Trajectory Exchange

ASAS Applications

Op's Requirements

- Point to Point Data Link
- CPDLC

FMS

EIS

Air Traffic Mngt Party Line?

Surveillance Addt'l Broadcast Data Link

Data Link technology Assesment ATN? Satcom SDLS?

FMS Prediction , Intent Functions Criticity Growth Potential Flexibility Variability

EIS Growth Potential Symbology Flexibility Variability

Traffic Computer ACAS Computer Integration ASAS Application.

New Data Link Technology Assesment L band ? Link 16??

Improved SATNAV

Weather Information Processing ?

L band Cabinet Integration?

What is missing…

- Operational vision consensus
- Clear definition of roles and responsibilities including procedures and liabilities
- Regulatory and economical situation assessment
- Interoperability definition
  - ✓ Worldwide vs Regional vs National
  - ✓ Several solutions may co-exist as far as interoperable
  - ✓ Transition scenarios
- Path to Certification of complex distributed systems still to be explored

What AT Alliance is proposing…

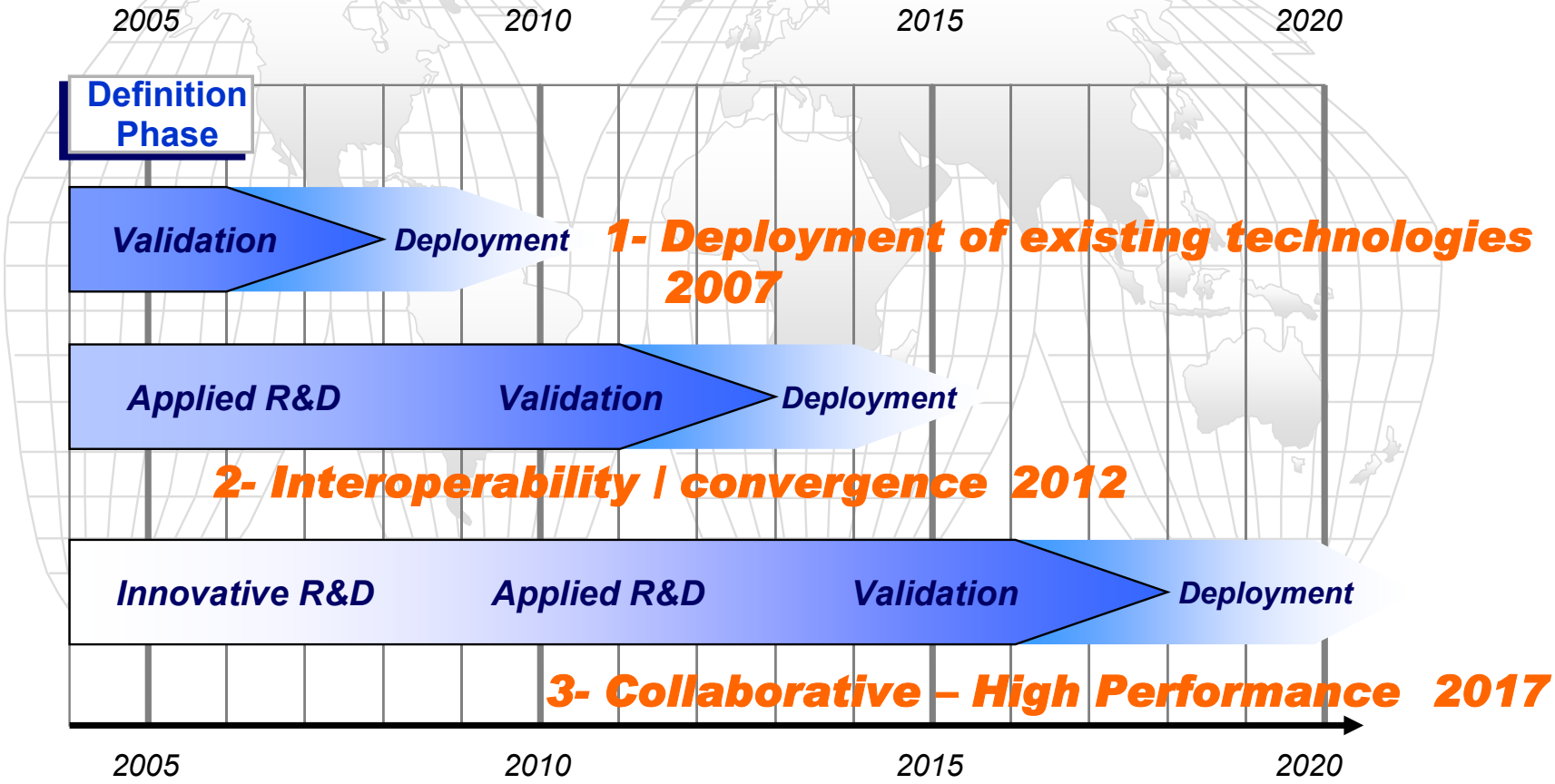
- Air & Ground integrated approach promoted by the AT Alliance
- Proposal for an industrial Implementation Programme in support of the Single European Sky
- Food for thought handed to the European Commission (Outline for a definition phase)
- Roadshow with major stakeholders in progress

An European Industry Initiative

- **Launch of a large scale Industrial Programme allowing to:**
  - ✓ **Mobilise and focus needed Research and validation investments against a well-defined ATM Master Plan owned by ATM stakeholders,**
  - ✓ **Guarantee that current and future European Industry and ATM stakeholders' investments in new air traffic solutions are effectively transformed into practical deployment,**
  - ✓ **Construct a holistic ATM Network integrating aircraft, avionics, space and ground ATM systems together,**
  - ✓ **Deploy an interoperable ATM Network that delivers safety, capacity, security and environmental benefits while accommodating all types of aircraft at an affordable cost.**

Proposed ATM Implementation Strategy:

3 major co-ordinated air and ground Improvement 'Packages'



Conclusion

- **A new collaboration framework for major deployment efforts:**
  - ✓ Combining Industry Capabilities with Operational, Military, Social, Political, Economical and Institutional Requirements
  - ✓ Implementing Co-ordinated ATM changes within a global Interoperability Framework (US, Europe, Asia, other regions)
  - ✓ Developing large-scale Validation Trials with mixed aircraft fleets
  - ✓ Placing the Human Being, ie. **Pilots and Controllers** at the centre of ATM system automation

Need for a new deployment framework and process to Research, Validate and Implement new and Human-centric air traffic solutions

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Thank you for your Attention